

Asset Management

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A Utility Dodges Pipe Breaks With Solid Planning

Under a sweeping asset management program, a municipal water utility targeted distribution system vulnerabilities and planned cost-effective pipe replacements. **BY BEN GROENEWEG AND CAMILLE GEORGE RUBEIZ**

FORT WAYNE, Indiana's second-largest city, was first incorporated in 1829. Like other older US cities, Fort Wayne has had to replace much of its water infrastructure over the years. But when the city began experiencing more than 500 water main breaks per year in the early 2000s, city engineers knew a thorough asset management program was needed to pinpoint where the next break might occur and to examine future vulnerabilities. At the time, break repairs cost the city roughly \$5,000 per incident.

PREPARING A PLAN

Fort Wayne created a utility asset management team to assess the city's water infrastructure. The team collected data from nearly 11,000 water main breaks that had occurred since 1974 and performed statistical analyses on 1,369 miles of pipe.

The team also built linear regression curves for pipe materials. Like those of other US cities, Fort Wayne's thick 4- and 6-in.-diameter cast-iron (CI) pipes, installed from 1900 to 1929, were manufactured by pouring molten iron into sand molds—a process that couldn't produce thinner pipes. The pipes were so thick that systems were highly over-designed to prevent internal failures. Engineers thought the pipes would blow up

from inside because of excessive internal pressure surges. It wasn't then understood that pipes could and would weaken from the outside because of corrosion, depending on soil conditions.

Technology advances soon led pipe manufacturers to develop spun CI pipe with thinner walls. Cities across the United States, including Fort Wayne, began switching to this less-expensive pipe from 1940 to 1970. Unfortunately, spun CI pipe is also vulnerable to external corrosion, weakening and thinning the pipe wall from the outside.

ASSET MANAGEMENT IN ACTION

Beginning in 2011, Fort Wayne City Utilities launched a comprehensive asset management program, encompassing water, sewer, and stormwater systems. The program's goal is to identify pipes most likely to fail, implement best replacement practices, and systematically reduce or eliminate future breaks while curtailing anticipated expenses.

Because of the city's asset management program, well-defined city districts were targeted for pipe replacement. The city's core was developed in the 1920s when the municipal waterworks used a well system. In the 1960s and 1970s, incredible growth from industrial and suburban expansion occurred. Areas where most of the failures occurred were outside the core and

are now receiving the most attention. City data showed that pipes installed between 1940 and 1970 were almost twice as likely to fail as installations that occurred during the 1920s and earlier.

The data analyses were used in a presentation to the city council, constituents, and water customers to support a significant 2012 rate increase request. City engineers used the pipe failure data to build a prediction chart showing two paths. One path demonstrated pipe failure rates continuing persistently if nothing was done. The second path focused on a spending plan with long-term asset management as a core objective, strategically replacing miles of water main with high potential for problems. Included was a historical review that revealed how many breaks were avoided by work done since 2000. The break analyses and prediction model were also used to show how many water main ruptures were avoided based on the number of pipes in the ground and preemptive actions taken. Putting strategic controls in place to minimize long-term funding drains was crucial.

After the presentation, the city council agreed on and floated the rate increase. Indiana's Utility Regulatory Commission also reviewed and approved the plan. Constituents and customers concerned about damages and inconvenience resulting from main breaks within neighborhoods also agreed.



Fusion-joining HDPE pipe sections together allowed Fort Wayne City Utilities to prevent breaks or separation between 20-ft lengths of pipe.

Upon receiving all needed endorsements, the Fort Wayne utility asset management team built a conditioned and strong scoring mechanism to prioritize the pipe sections needing replacement. Statistical evidence for all failed assets was collected, and a scoring scale of 1–5 was put in place to determine how likely it was for a particular asset to fail.

The work considered pipe location, installation era, and diameter. After exploring available materials, the team selected high-density polyethylene (HDPE) pipe for its infrastructure replacement needs. Besides corrosion resistance, HDPE pipe sections can be fusion-joined to prevent breaks or separation between 20-ft lengths of pipe while providing a zero-leak system, reducing water loss by as much as 5.9 mgd. Fort Wayne has been using plastic pipe for asset replacement since 2000, particularly in residential neighborhoods. In these areas, spun, thinner-walled CI pipes were shown to

fail more quickly than the older, thicker pipes.

Iron mains of 4- and 6-in. diameter are often found in older, established neighborhoods. City engineers chose a horizontal directional drilling (HDD) installation approach because the method diminishes the need to disrupt traffic and tear up sections of neighborhood thoroughfares. Trenchless installation methods minimize such concerns. By measuring the number of breaks in the shortest amount of time, it was obvious, at first, where the most severe problems were. After the top-priority replacement challenges were addressed, it became a question of prioritizing the next three or four neighborhoods, which had about the same number of breaks.

A condition and criticality model for neighborhoods and areas was created, along with a matrix. In working with the city's senior water engineer, the asset management team reached a decision

based on condition scores. The criticality score—measuring the possible consequences if an asset fails—has nothing to do with a condition score. For instance, if there's only one water main supplying the hospital, even if it's new, this pipe would still score a 5 on criticality assessment given the severe consequences of a failure.

Asset management team members used their equations, analyses, matrices, and risk-exposure scores to develop extensive tiered-assessment calculations and determine project precedence and resource allocations. The matrices and scores were also used by the city's engineers and geographic information system team to build a visual platform for constituents that readily addressed questions such as why a customer's block or area wasn't chosen for attention first, detailing the criteria, condition maps, criticality maps, and risk exposure maps used to determine project priority.

MOVING FORWARD

With its assessments, calculations, and analytical processes, Fort Wayne's asset management program provides a solid path forward for substantive, methodical decision making, enabling the city to align results with available resources. A robust asset management program affirms spending rationale, identifies urgent necessities, and sets expectations for the future.

The asset management program also builds credibility and helped Fort Wayne City Utilities pass the 2012 rate increase. When the city prepares for its next water rate increase, the established program can swiftly and clearly show the number of water main breaks the program reduced and controlled. The utility also will be able to provide assurance that future rate increases can yield predictable results. Backed by documented evidence, the asset management program bolsters the community's confidence that beneficial decisions are being made for its future health and economic well being. 